ACCOMPLISHMENTS OF THE
BUREAU OF AGRICULTURAL CHEMISTRY AND ENGINEERING,
U. S. DEPARTMENT OF AGRICULTURE

Remarks of Dr. Henry G. Knight upon receipt of the Medal of the American Institute of Chemists from Vice President Wallace at the Wardman Park Hotel in Washington, D. C., Saturday evening, May 17, 1941.

--ooOoo--

Mr. Vice President! Mr. Toast Master! Ladies and Gentlemen!

I accept with humility the honor that is being bestowed upon me tonight. It is all right, I suppose, for a chemist to express his satisfaction over the results of research, just as it is all right for an artist to admire his painting. But when you single out a chemist and publicly acclaim his accomplishments and arrange an affair of such signal honor as the American Institute of Chemists does when it presents its annual medal, the ceremony is so impressive that it is sometimes difficult for the recipient to properly express his appreciation. That's about the way I feel now.

However, when I look over there on the wall at the pictures of the persons who have passed through a similar experience to the one I am going through tonight, it gives me the courage to say thank you, from the bottom of my heart. The 13 men and one woman who have been the recipients of this medal have added materially to the world's fund of knowledge in the chemical field, and the results of their efforts have helped to make America a better place in which to live. It is a pleasure for me to have my name associated with the names of the distinguished persons who have received the Institute's medal. I accept the honor, Mr. Toast Master, and give you permission at this time to add my name to the names of those who have received this honor in the past.

As the recipient of this medal I assure you that I appreciate the honor that goes with it. And I know that I would not be receiving this honor had it not been for the loyalty and cooperation of the hundreds of men and women who have worked with me during the past years. I therefore desire to share this honor with my former and present colleagues and, particularly, with the men and women of the organization which I now represent, the Bureau of Agricultural Chemistry and Engineering of the United States Department of Agriculture.

In honoring me you have honored my fellow workers and spot-lighted the research work of the Department of Agriculture. We all appreciate this recognition. I believe the Bureau of Standards is the only other Government agency that has shared in the Institute's awards. The other awards, since started in 1926, have gone to persons in industry and in research and educational institutions.

And now, according to the precedent that has been established, it becomes my duty as the recipient of this year's medal to recite some of the accomplishments of the organization which I represent. That's done, I suppose, so that the Institute members and guests may determine whether or not the committee was wise in its selection of the medalist. Please understand that I recite these accomplishments not in a boastful way, but merely to high-light the results of some of our most successful research.

There is every indication that the bluegrass region of Kentucky--famous for its beautiful women, fast horses, and good whiskey--possesses a soil that has an ideal combination of such desirable chemical elements

as manganese, calcium, phosphorus, nitrogen, iodine, and potash. There are other soils in some parts of the country that contain undesirable elements. The one element that has caused the most trouble is selenium. Selenium is a twin sister to sulfur and is toxic to plants and animals. Each year thousands of cattle and sheep in parts of some of the Western States die from eating plants that have absorbed selenium from the soils on which they grew. In years past I have followed the course of a herd of sheep for more than twenty miles across the plains of Wyoming by the dead animals poisoned by eating woody aster which I now know contains enormous quantities of selenium.

Investigations by scientists of the Department of Agriculture and of Wyoming and other Western States showed that selenium is present in large enough quantities to make it an agricultural problem in the soils and vegetation in some parts of the country, particularly in some areas with a rainfall of less than 20 inches a year. These investigations also revealed that seleniferous areas are closely correlated with certain geological formations. As a result of this research we know a great deal about selenium today. We know where to look for the trouble, and how to avoid it in many cases. These investigations have revealed the cause of heavy monetary losses to livestock producers in certain areas of the West, as well as calling attention to the danger to people from the consumption of foods produced on seleniferous soils. The man who conducted some of the most outstanding selenium investigations is a member of the American Institute of Chemists. He is here tonight.

In 1933 Senator Pat Harrison asked the Department of Agriculture if the results of any of its investigations gave promise of benefiting the Southern farmer. He was told that we had learned how to extract starch from sweetpotatoes. He got a WPA grant of $150,000 and was instrumental in getting a sweetpotato starch plant established in an old abandoned sawmill building at Laurel in the southern part of his home State of Mississippi.

That plant, the only one of its kind in this country, manufactured 140,000 pounds of high grade white starch in 1934, and increased production each year until it ground around 275,000 bushels of potatoes and turned out nearly 3 million pounds of starch in 1939. The cost of manufacturing this starch was reduced from 13 cents a pound the first year to about 3 cents a pound last year. Sweetpotato starch can now be used to replace an imported product. In addition to that, it offers Southern farmers another cash outlet for one of their major crops. About 1,000 cooperative sweetpotato farmers who control the starch plant are profiting from the results of this research. The Laurel plant which had to be operated largely on a pilot plant basis for the first few years, made a profit for the first time in 1939. The starch may be used for sizing in textile mills, in laundries and other industries, as well as for food purposes. A trial test in the Bureau of Engraving and Printing showed that dextrin made from sweetpotato starch could be used for the adhesive on postage stamps. Further investigations with the sweetpotato revealed that a high grade carbohydrate livestock feed can be made from it. As a result of these ventures a livestock feed has been manufactured from sweetpotatoes at

St. Francisville, Louisiana, and a full-fledged sweetpotato livestock feed plant is being established in Alabama. I am proud to say that a member of the organization I represent is largely responsible for the development of this new and promising Southern industry. He is here tonight.

The gay fast colors that some of the men and women are wearing here this evening, and that are being worn rather generally today throughout the country are largely the result of research by chemists of the United States Department of Agriculture. This research developed new technical methods for the production of intermediates, fast and brilliant dyes for cotton. It was started because the World War in 1917 cut off our supplies of German dyes which were the best in the world at that time. The American dyes of today are equal to those that are produced anywhere else. It is no longer necessary for us to go outside of this country for our dyes. This one piece of research has expanded the cotton market millions of dollars a year. One of the men who played an important part in this dye work is sitting at this banquet table tonight.

It was said a few years ago that you couldn't produce good cucumber pickles in the South on account of the hot weather. So cucumber growing in that region was confined largely to production for the fresh vegetable market, until recent research by scientists of the Department and the North Carolina Experiment Station showed that with a slight modification of the pickling methods used in the North, quality products could also be produced under Southern conditions.

It is now possible and practical to pack high-quality fermented cucumber pickles, including dill pickles which are the hardest to produce, in the South. Thousands of farmers are now benefiting from this new development in North Carolina where the work was started a few years ago. As a result of this research North Carolina has become the fourth largest pickle producing State in the country. One of the men responsible for this development is with us this evening.

At the Bureau's Soybean Laboratory at Urbana, Illinois, considerable progress has been made in the development of paints, varnishes and enamels from the oil of the soybean, and in making plastics from the meal which is the residue that is left after the oil has been extracted. Partly as a result of the research at this laboratory great quantities of paint containing soybean oil are now sold.

One paint company alone reports that it has made and sold more than a million gallons of soybean oil paint. The more desirable paint oils, like tung oil and linseed oil, are known in the technical trade as "drying oils" because they permit the paint to dry rather rapidly. Since the natural soybean oil does not dry very fast the chemists had to try to develop methods to make it dry faster so that it could be satisfactorily used in the manufacture of paints and varnishes. They did develop them. And now soybean paint may be used for painting houses, barns and other objects. I might say that soybean paint is being tried experimentally for marking streets and highways. This requires a <u>very</u> quick drying paint so as not to hold up traffic, and if the soybean paint can measure up to this test it will help in the industrial utilization of the soybean crop.

Many oranges, though ripe, lack the full yellow color which the public associates with a ripe orange. This condition which is particularly prevalent with some varieties during the early part of the harvesting season curtailed the marketing a great deal until Department chemists solved the problem by treating these green-colored oranges with ethylene gas. The treatment simply bleaches out the predominant green color and leaves the orange a beautiful natural yellow. The chemical investigations leading to the development of this treatment which is now in rather general use cost the taxpayers of the country about $4,000 and is estimated to be worth about $4,000,000 a year to the producers of citrus fruits in Florida alone and about the same amount to producers in California. And yet some people say that research doesn't pay. I know it does. I think the criticism that sometimes comes to research comes mainly because the scientists are forced to try the results of their laboratory investigations on a commercial scale before they have had time to pick out all of the "operating bugs." That happened in the case of the sweetpotato starch plant, and it's likely to happen to any undertaking that is pushed too fast. Developments and discoveries and inventions take painstaking time for checking and rechecking, and they shouldn't be pushed too rapidly.

In the summer of 1928 I asked the then Assistant Chief of our Bureau to go to the Wenatchee Valley in Washington to see if he could help find a substitute for the arsenate of lead that apple growers were forced to apply in excessive amounts in an effort to protect their fruit from the insects. He came back and told me that the trees were sprayed so heavily that they looked like they had been whitewashed.

In an effort to help solve this problem we put scientists to searching for substitutes for arsenate of lead. It was necessary for this substitute to do four things. It must kill the insects, not injure the foliage, be economical to use, and harmless to those who consumed the fruit. That was quite an assignment but the investigators tackled it.

Organic compounds containing sulfur were selected as promising substitutes since sulfur had already proved its value as an insecticide. After considerable research extending over quite a period of time the investigators tried a product made by reacting sulfur and diphenylamine. This product, known as phenothiazine, proved extremely toxic to mosquito larvae which was the only insect available to the entomologists for laboratory tests at that time. Well, to make a long story short, it was found that it killed insects, that it was harmless to the foliage, and that it could be manufactured at a reasonable cost. That left only one test, namely, to show whether it was poisonous, especially to human beings.

This test was first made with white rats at the Bureau's pharmacological laboratory at the Stanford University School of Medicine in San Francisco. It was later made with rabbits. These investigations revealed that no matter how much phenothiazine the animals got they continued to live. This checked off the fourth and last requirement and the investigators felt that they had at last found an insecticide that gave great promise of being a substitute for arsenate of lead.

But that was not all. We sometimes start out to look for the answer to one problem and wind up with something entirely different. That happened in this case. During the pharmacological investigations it was revealed that phenothiazine had some value as a urinary antiseptic. This is something that has been long needed. One of our own investigators volunteered for the first test of its effects on human beings. The result was satisfactory. Then the Stanford Medical School joined with us to test phenothiazine on a clinical basis. A group of 61 patients with urinary tract infections was selected for this test. All but 8 were either cured or definitely relieved.

Encouraged by promising findings it was reasoned that if phenothiazine killed lower forms of life like insects and was non-poisonous to the higher forms that it might be used as an anthelmintic for intestinal infestations of sheep, hogs, and other domestic animals. A quantity of the chemical was synthesized and sent to the Bureau of Animal Industry where it was used and found to be very effective against some of the most resistant intestinal parasites as well as being generally effective against many other types of infestation. Phenothiazine is now used extensively as an anthelmintic and that one "find" in the very beginning of its use is already worth thousands of dollars to the livestock industry in this country. Two of my colleagues who did the original phenothiazine work are here tonight.

I assume that most of you are familiar with the Department of Agriculture's new Regional Research Laboratories which I have been asked

to discuss. But to refresh your memory and for the benefit of those who have not heard of this new program let me give you a brief review of this rather extensive Government undertaking.

The Department of Agriculture has been searching for industrial uses for farm products in a limited way for 25 or 30 years, and has some rather outstanding accomplishments to its credit. But searching for industrial outlets for farm products was a sort of a side line compared to the main agricultural program. It was confined largely to work on byproducts or what we used to call farm wastes until the surpluses forced us to start searching for more profitable outlets for the surplus crops. Congress became so interested in this industrial utilization idea that it authorized an annual appropriation of four million dollars in 1938 and instructed the Secretary of Agriculture to establish and maintain four Regional Research Laboratories, one in each of the major farming areas of the country to search for new and wider industrial outlets and markets for farm products.

After a careful survey, these laboratories were located at Peoria, Illinois, for the Northern part of the country; New Orleans, Louisiana, for the South; Philadelphia, Pennsylvania, for the East; and Albany, California, for the West. The Northern Laboratory is searching for new and wider industrial outlets and markets for corn, wheat, and agricultural residues or waste. The Southern Laboratory is working on cotton, sweetpotatoes, and peanuts; the Eastern Laboratory on apples, tobacco, milk products, potatoes, vegetables, animal fats

and oils, hides, skins and tanning materials; and the Western Laboratory on wheat, potatoes, apples, vegetables, fruits, alfalfa, and poultry products and byproducts.

All four of the laboratories have been occupied and research is now under way at these places. There is an average of more than 40 scientists employed at each of the laboratories, or a total of more than 175 at the four. There are about 25 sub-professional employees plus the clerical and administrative help. There are altogether more than 400 persons already at work in these laboratories and the staffs are being enlarged. The expansion will continue until there will be a total of between 800 and a thousand scientists searching for industrial outlets for farm crops in the four laboratories. This, as you can see, is an enormous program filled with great possibilities, but with few milestones to guide the searchers. The investigators in these laboratories are moving as fast as it is humanly possible with their research work and every possible effort is being made to inaugurate projects that promise immediate help to the farmer.

On account of the size of this new research program we are able to approach the problem on a larger scale than we've ever been able to do before. This will be very helpful. One of the reasons research in the utilization of farm products has moved slowly in the past is because the educational institutions which do agricultural research have not had the money to carry their findings beyond the test tube stage, which is only the first in several steps in the development of a new product. In order to shorten the gap between test tube discoveries and commercial

production, these new research laboratories are establishing what are called "pilot plants." These are really small commercial plants, but large enough to enable the checking of laboratory findings before they are turned over to industry.

Industry has found the pilot plant method of checking on the commercial development of an article a very profitable part of its research program. It has followed this method for a good many years. But pilot plant research is far more expensive than test tube investigations, and this is the first time agricultural workers have had sufficient funds to take their findings much beyond the test tube stage.

It may interest you to learn that one entire wing, or roughly one-third, of each of these four research laboratories is being utilized for pilot plant work. A large pilot plant is now under construction at the Northern Laboratory at Peoria, Illinois, for the study of motor fuel from farm crops. A pilot plant is being constructed at the Western Laboratory at Albany, California, to study the frozen fruit and vegetable work. The pilot plant wing at the Philadelphia Laboratory was just recently finished, and the wing for this work at the New Orleans Laboratory will be completed during the summer.

Naturally I can't report very much in the way of progress from these new laboratories because our research is just getting under way. But I feel that we have done a pretty good job in getting started as soon as we have, considering the tremendous difficulties we had to

encounter in pioneering a program of this kind. I feel that my colleagues--the men who have borne the brunt of developing this program--are entitled to a vote of thanks for the good work they have done. Some of them were originally in the Department of Agriculture, some came from industry and some from educational institutions. They have come from all parts of the country and are specialists in a great many fields. When I think of these laboratories I like to think of these intensely interested scientists busy at their tasks rather than the imposing structures of brick and stone in which they work. Ideas are what count, and it's ideas that we need in this new program. A scientist with a continuing flow of ideas is a valuable person in our work even though only a small percentage of his ideas are workable.

World conditions have changed a great deal since these laboratories were authorized in 1938, and it is a comforting thought to know that these laboratories could be turned into research institutions for national defense should the occasion demand.

We import most of our root starches, much of our tin, and practically all of our rubber from the East Indies. Half of our tanning materials and something like half of our linseed oil comes from South America, and practically all of our tung oil comes from China. If we should lose the freedom of the seas and be cut off from the rest of the world our export trade would drop below the low mark where it now stands. It is reasonable to assume that such a situation would further increase the surplus problem and make it necessary for us to create in this

country, if possible, greatly expanded markets for many of our major farm crops. That is the object of the laboratory program.

So it seems to me that the establishment of these pioneering laboratories marks an epoch in the application of science to the solution of one of our great agricultural problems. They can be useful in a great many ways, and I look forward to the time when I may give you a more detailed report on the accomplishments from these halls of Chemistry and Engineering.
